ELECTRONICS

6189

TWIN TRIODE

Five-Star Tube

★★★★★

FOR GENERAL-PURPOSE APPLICATIONS

MEDIUM-MU — **SHOCK, VIBRATION RATINGS**
9-PIN MINIATURE — **HEATER-CYCLING RATING**
SEPARATE CATHODES

DESCRIPTION AND RATING

The 6189 is a miniature medium-mu twin triode suitable for a wide variety of general-purpose amplifier, oscillator, and multivibrator applications.

The 6189 is a special-quality tube intended for use in critical industrial and military applications in which operational dependability is of primary importance. Features of the tube include a high degree of mechanical strength and a heater-cathode construction capable of withstanding many-thousand cycles of intermittent operation. When used in on-off control applications, the tube will maintain its emission capabilities after long periods of operation under cutoff conditions.

GENERAL

ELECTRICAL

Cathode - Coated Unipotential

Heater Characteristics and Ratings

	Parallel*	Series‡	
Heater Voltage, AC or DC	6.3±0.6§	12.6±1.3§	Volts
Heater Current	0.3¶	0.15#	Amperes

Direct Interelectrode CapacitancesΔ

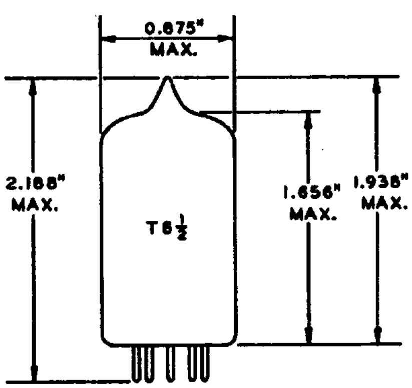
Grid to Plate: (g to p), Each Section	1.5	pf
Input: g to (h + k), Each Section	1.6	pf
Output: p to (h + k), Section 1	0.5	pf
Output: p to (h + k), Section 2	0.4	pf

MECHANICAL

Operating Position - Any
Envelope - T-6 1/2, Glass
Base - E9-1, Small Button 9-Pin
Outline Drawing - EIA 6-2

Maximum Diameter	0.875	Inches
Maximum Over-all Length	2.188	Inches
Maximum Seated Height	1.938	Inches

PHYSICAL DIMENSIONS

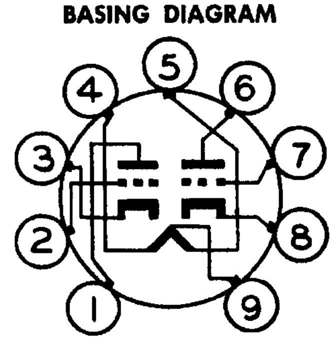


EIA 6-2

TERMINAL CONNECTIONS

Pin 1 - Plate (Section 2)
Pin 2 - Grid (Section 2)
Pin 3 - Cathode (Section 2)
Pin 4 - Heater
Pin 5 - Heater
Pin 6 - Plate (Section 1)
Pin 7 - Grid (Section 1)
Pin 8 - Cathode (Section 1)
Pin 9 - Heater Center Tap

BASING DIAGRAM



EIA 9A

MAXIMUM RATINGS

ABSOLUTE-MAXIMUM VALUES, Each Section

DC Plate Voltage	300	Volts
Positive DC Grid Voltage	0	Volts
Negative DC Grid Voltage	55	Volts
Peak Positive Grid Voltage	60	Volts
Plate Dissipation	3.0	Watts
Grid Dissipation	0.4	Watts
DC Grid Current	5.0	Milliamperes
DC Cathode Current	20	Milliamperes
Peak Cathode Current - See Rating Chart		
Heater-Cathode Voltage		
Heater Positive with Respect to Cathode	100	Volts
Heater Negative with Respect to Cathode	100	Volts
Grid Circuit Resistance		
With Fixed Bias	0.5	Megohms
With Cathode Bias	1.0	Megohms
Bulb Temperature at Hottest Point	165	C

Absolute-Maximum ratings are limiting values of operating and environmental conditions applicable to any electron tube of a specified type as defined by its published data and should not be exceeded under the worst probable conditions.

The tube manufacturer chooses these values to provide acceptable serviceability of the tube, making no allowance for equipment variations, environmental variations, and the effects of changes in operating conditions due to variations in the characteristics of the tube under consideration and of all other electron devices in the equipment.

The equipment manufacturer should design so that initially and throughout life no absolute-maximum value for the intended service is exceeded with any tube under the worst probable operating conditions with respect to supply-voltage variation, equipment component variation, equipment control adjustment, load variation, signal variation, environmental conditions, and variations in the characteristics of the tube under consideration and of all other electron devices in the equipment.

CHARACTERISTICS AND TYPICAL OPERATION

AVERAGE CHARACTERISTICS, Each Section

Plate Voltage	250	Volts
Grid Voltage	-8.5	Volts
Amplification Factor	17	
Plate Resistance, approximate	7700	Ohms
Transconductance	2200	Micromhos
Plate Current	10.5	Milliamperes
Grid Voltage, approximate		
Ib = 10 Microamperes	-24	Volts

NOTES

* Operated with the two sections of the heater connected in parallel.

‡ Operated with the two sections of the heater connected in series.

§ The equipment designer should design the equipment so that heater voltage is centered at the specified bogey value, with heater supply variations restricted to maintain heater voltage within the specified tolerance.

¶ Heater current of a bogey tube at Ef = 6.3 volts.

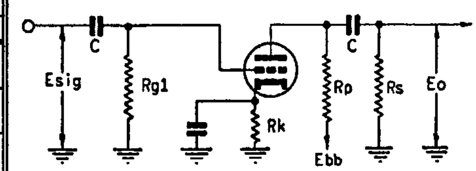
Heater current of a bogey tube at Ef = 12.6 volts.

Δ Without external shield.

CLASS A RESISTANCE-COUPLED AMPLIFIER

EACH SECTION

Rp Meg.	R_s Meg.	R_{g1} Meg.	Ebb = 90 Volts Rk	Gain	Eo	Ebb = 180 Volts Rk	Gain	Eo	Ebb = 300 Volts Rk	Gain	Eo
0.10	0.10	0.10	3900	10	10	3600	11	20	3500	11	30
0.10	0.24	0.10	5000	11	14	4700	12	27	4400	12	41
0.24	0.24	0.10	9400	11	13	8700	11	25	8700	12	38
0.24	0.51	0.10	11000	11	17	11000	12	32	11000	12	48
0.51	0.51	0.10	19000	11	15	18000	12	29	18000	12	43
0.51	1.0	0.10	24000	11	19	23000	12	37	23000	12	54
0.24	0.24	10	0	14	12	0	16	20	0	17	28
0.24	0.51	10	0	14	16	0	16	28	0	17	40
0.51	0.51	10	0	14	15	0	15	26	0	16	38
0.51	1.0	10	0	14	19	0	16	35	0	16	52



Note: Coupling capacitors (C) should be selected to give desired frequency response. Rk should be adequately by-passed.

Notes: 1. Eo is maximum RMS voltage output for five percent (5%) total harmonic distortion. 2. Gain measured at 2.0 volts RMS output. 3. For zero-bias data, generator impedance is negligible.

CHARACTERISTICS LIMITS

		Minimum	Bogey	Maximum	
Heater Current Ef = 12.6 volts.	Initial	138	150	162	Milliamperes
	500-Hr	138	---	164	Milliamperes
	1000-Hr	138	---	166	Milliamperes
Plate Current, Each Section Ef = 12.6 volts, Eb = 250 volts, Ec = -8.5 volts.	Initial	6.5	10.5	14.5	Milliamperes
Plate Current Difference between Sections Difference between plate currents for each section at Ef = 12.6 volts, Eb = 250 volts, Ec = -8.5 volts.	Initial	---	---	3.5	Milliamperes
Transconductance, Each Section Ef = 12.6 volts, Eb = 250 volts, Ec = -8.5 volts. .	Initial	1750	2200	2650	Micromhos
Transconductance Change with Heater Voltage, Each Section Difference between transconductance measured at Ef = 12.6 volts and transconductance at Ef = 11.4 volts (other conditions the same) expressed as a percentage of transconductance at Ef = 12.6 volts.	Initial	---	---	10	Percent
	500-Hr	---	---	10	Percent
	1000-Hr	---	---	15	Percent
Transconductance Change with Operation, Each Section Difference between transconductance measured initially and after operation expressed as a percentage of the initial value	500-Hr	---	---	15	Percent
	1000-Hr	---	---	20	Percent
Average Transconductance Change with Operation Average of values for "Transconductance Change with Operation, Each Section"	500-Hr	---	---	8	Percent
	1000-Hr	---	---	10	Percent
Amplification Factor, Each Section Ef = 12.6 volts, Eb = 250 volts, Ec = -8.5 volts	Initial	15.5	17	18.5	
Plate Current Cutoff (1), Each Section Ef = 12.6 volts, Ebb = 250 volts, Ec = -30 volts, R_L = 0.1 meg	Initial	---	---	20	Microamperes

CHARACTERISTICS LIMITS (Cont'd)

		Minimum	Bogey	Maximum	
Plate Current Cutoff (2), Each Section Ef = 12.6 volts, Eb = 250 volts, Ec = -18 volts	Initial	5	---	---	Microamperes
Pulse Cathode Current, Each Section Ef = 12.6 volts, Eb = 250 volts, Ec = -45 volts, Rk = 1.0 ohms, egk = +55 volts, tp = 10 μsec, prr = 1000 pps, tr = 1.0 μsec, tf = 1.0 μsec	Initial	400	---	---	Milliamperes
	500-Hr	300	---	---	Milliamperes
Pulse Cathode Current at Reduced Heater Voltage, Each Section Ef = 11.4 volts, Eb = 250 volts, Ec = -45 volts, Rk = 1.0 ohms, egk = +55 volts, tp = 10 μsec, prr = 1000 pps, tr = 1.0 μsec, tf = 1.0 μsec	Initial	350	---	---	Milliamperes
Interelectrode Capacitances					
Grid to Plate: (g to p), Each Section	Initial	1.20	1.50	1.80	Picofarads
Input: g to (h + k), Each Section.	Initial	1.25	1.60	1.95	Picofarads
Output: p to (h + k), Section 1	Initial	0.30	0.50	0.70	Picofarads
Output: p to (h + k), Section 2	Initial	0.20	0.40	0.60	Picofarads
Measured without external shield.					
Negative Grid Current, Each Section Ef = 12.6 volts, Eb = 250 volts, Ecc = -8.5 volts, Rg = 0.5 meg	Initial	0	---	0.5	Microamperes
	500-Hr	0	---	0.5	Microamperes
	1000-Hr	0	---	0.5	Microamperes
Heater-Cathode Leakage Current, Each Section Ef = 12.6 volts, Ehk = 100 volts					
Heater Positive with Respect to Cathode.	Initial	---	---	7	Microamperes
	500-Hr	---	---	7	Microamperes
	1000-Hr	---	---	7	Microamperes
Heater Negative with Respect to Cathode.	Initial	---	---	7	Microamperes
	500-Hr	---	---	7	Microamperes
	1000-Hr	---	---	7	Microamperes
Interelectrode Leakage Resistance, Each Section Ef = 12.6 volts. Polarity of applied d-c interelectrode voltage is such that no cathode emission results.					
Grid to All at 100 volts DC.	Initial	1000	---	---	Megohms
	500-Hr	500	---	---	Megohms
	1000-Hr	250	---	---	Megohms
Plate to All at 300 volts DC	Initial	1000	---	---	Megohms
	500-Hr	500	---	---	Megohms
	1000-Hr	250	---	---	Megohms
Grid Emission Current, Each Section Ef = 15.0 volts, Eb = 250 volts, Ecc = -30 volts, Rg = 0.5 meg	Initial	---	---	1.5	Microamperes
Cathode Interface Resistance, Each Section Ef = 5.7 volts (parallel heaters), Eb = 50 volts, Ec varied for Ip = 1.0 ma	500-Hr	---	---	50	Ohms
	1000-Hr	---	---	50	Ohms

SPECIAL PERFORMANCE TESTS

	Minimum	Bogey	Maximum	
Low Frequency Vibrational Output . . . . Statistical sample is subjected to vibration in each of two planes at 40 cps, with peak acceleration 10G. Tube is operated with Ef = 12.6 volts, Ebb = 250 volts, Ec = -8.5 volts, R_L = 2000 ohms, sections in parallel.	---	---	100	Millivolts, RMS
Swept-Frequency Vibrational Output. . . . . Statistical sample is subjected to vibration, swept from 50 to 2000 cps in 4 minutes, in each of two planes, with peak acceleration 10G. Tube is operated with Ef = 12.6 volts, Ebb = 250 volts, Ec = -8.5 volts, R_L = 2000 ohms, sections in parallel.	---	---	300	Millivolts, RMS

Low Pressure Voltage Breakdown Test

Statistical sample tested for voltage breakdown at a pressure of 21 millimeters Hg, to simulate an altitude of 80000 feet. Tubes shall not give visual evidence of flashover or corona when 500 volts RMS, 60 cps, is applied between the plate pins and adjacent pins.

DEGRADATION RATE TESTS

Fatigue

Statistical sample vibrated for a total of 96 hours, 32 hours in each of 3 planes, at a peak acceleration of 2.5 G. Frequency is 25 cps. Tubes are operated during the test with Ef = 12.6 volts (no other voltages applied). Following the test, tubes are evaluated for low-frequency vibrational output, heater-cathode leakage, grid current, and transconductance.

Shock

Statistical sample subjected to 5 impact accelerations of approximately 450 G in each of four positions. The accelerating forces are applied by the Navy-type, High Impact (flyweight) Shock Machine using a 30° hammer angle. Tubes are operated during the test with Ef = 12.6 volts, Eb = 250 volts, Ecc = -8.5 volts, Ehk = +100 volts, and Rg = 0.1 megohms. Following the test, tubes are evaluated for low-frequency vibrational output, heater-cathode leakage, grid current, and transconductance.

Stability Life Test

Statistical sample operated under the following conditions: Ef = 12.6 volts (cycled - on 1 3/4 hours, off 1/4 hour), Eb = 250 volts, Ecc = -8.5 volts, Ehk = 135 volts with heater positive with respect to cathode, Rg = 0.5 meg, and temperature = room temperature. Tubes are evaluated, following 2 hours and 20 hours of life test, for percent change in transconductance of individual tubes.

Survival Rate Life Test

Statistical sample operated under Stability Life Test conditions is evaluated for shorted and open elements and transconductance following approximately 100 hours of life test.

Intermittent Life Test

Statistical sample operated for 1000 hours under the following conditions: Ef = 12.6 volts (cycled - on 1 3/4 hours, off 1/4 hour), Eb = 250 volts, Ecc = -8.5 volts, Ehk = 135 volts with heater positive with respect to cathode, Rg = 0.5 meg, and bulb temperature = 165 C minimum. Tubes are evaluated, following 500 and 1000 hours of the life test, for shorted or open elements, heater current, transconductance, negative grid current, heater-cathode leakage, and interelectrode leakage resistance. Life test end points are given in "Characteristics Limits" section.

Cutoff Life Test

Statistical sample operated for 1000 hours under the following conditions: Ef = 12.6 volts, Eb = 250 volts, and Ec = -30 volts. Tubes are evaluated, following 500 and 1000 hours of the life test, for shorted or open elements, negative grid current, interelectrode leakage resistance, and cathode interface resistance. Life test end points are given in "Characteristics Limits" section.

DEGRADATION RATE TESTS (Cont'd)

Pulse Life Test

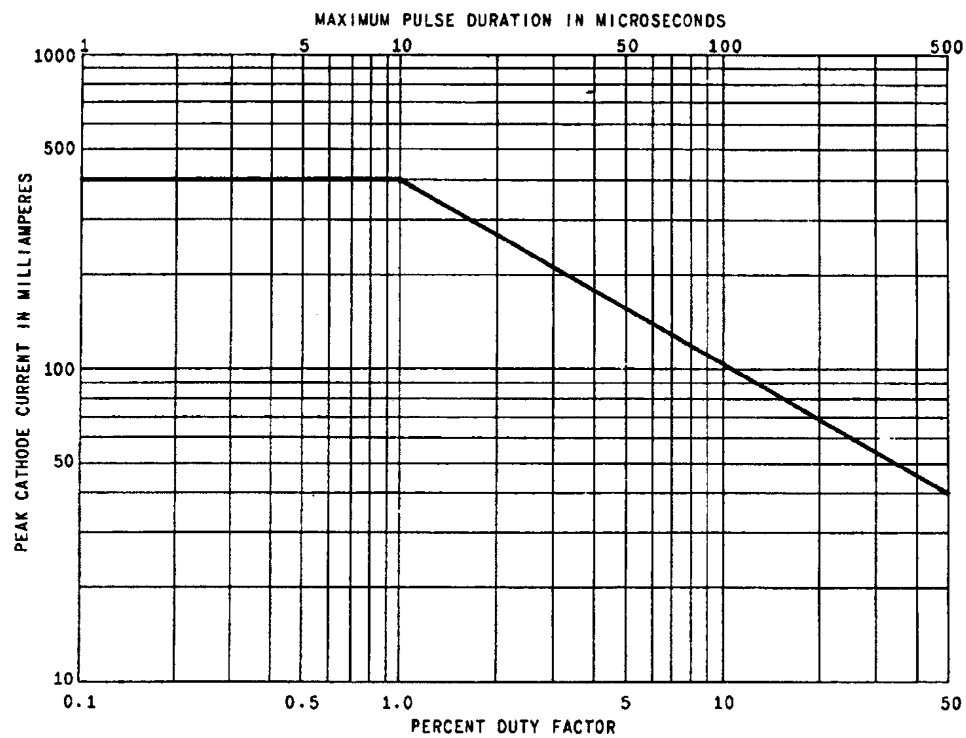
Statistical sample operated for 500 hours under the following conditions: Ef = 12.6 volts, Ebb = 300 volts, Ecc = -40 volts, egk = +60 volts, R_L = 180 ohms, Rg = 47 ohms, tp = 10 μsec, prr = 1000 pps, tr = 1.0 μsec, and tf = 1.0 μsec. Tubes are evaluated, following the life test, for shorted or open elements, pulse cathode current, negative grid current, and interelectrode leakage resistance. Life test end points are given in "Characteristics Limits" section.

Heater-Cycling Life Test

Statistical sample operated for 2000 cycles minimum to evaluate and control heater-cathode defects. Conditions of test include Ef = 7.5 volts (parallel heaters, cycled - on 1 minute, off 1 minute), Eb = Ec = 0 volts, and ehk = +135 volts. Following this test, tubes are evaluated for open heaters, heater-cathode shorts, and heater-cathode leakage current.

Note: The conditions for some of the indicated tests have deliberately been selected to aggravate tube failures for test and evaluation purposes. In no sense should these conditions be interpreted as suitable circuit operating conditions.

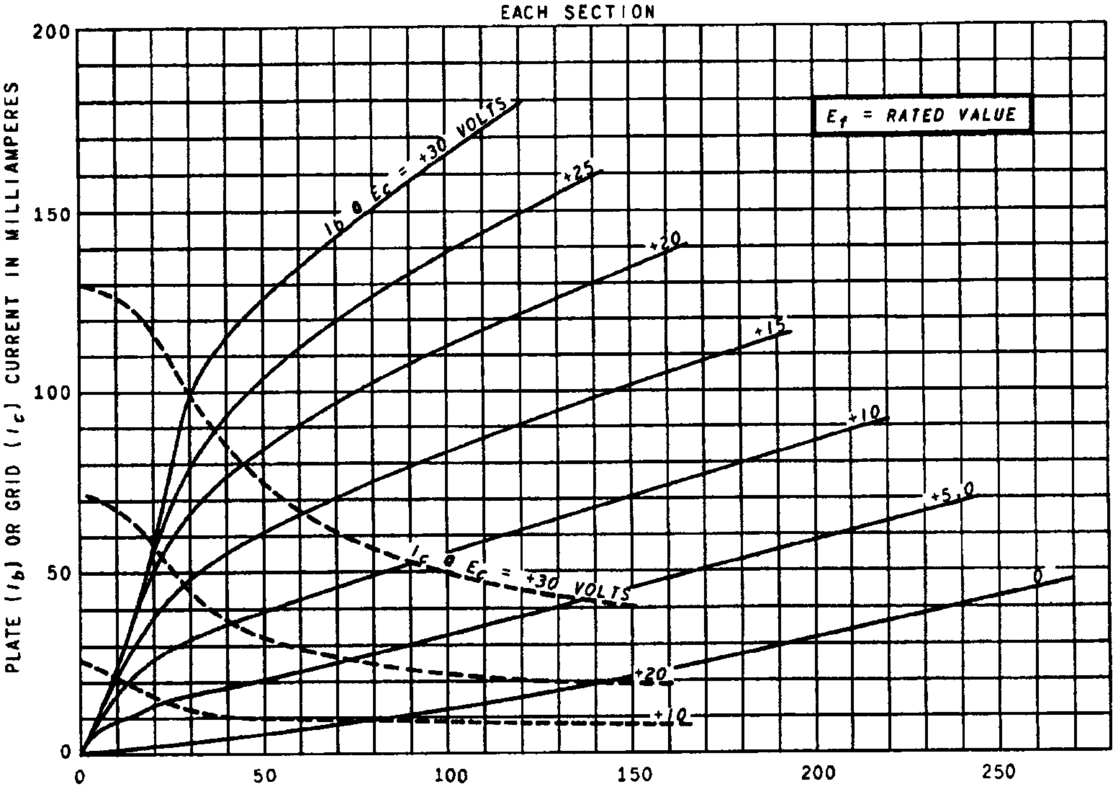
In the design of military equipment employing this tube, reference should be made to the appropriate MIL-E-1 specification.



The area below and to the left of the line establishes maximum peak cathode current per section for duty factors up to 50 percent. At duty factors greater than 50 percent, the maximum dc cathode current rating of 20 milliamperes serves to limit the peak current sufficiently. Four-hundred milliamperes is the maximum peak cathode current per section at any duty factor less than 0.1 percent. Duty factor is defined as the ratio of the average current to the maximum peak current occurring in any 1000-microsecond period.

AVERAGE PLATE CHARACTERISTICS

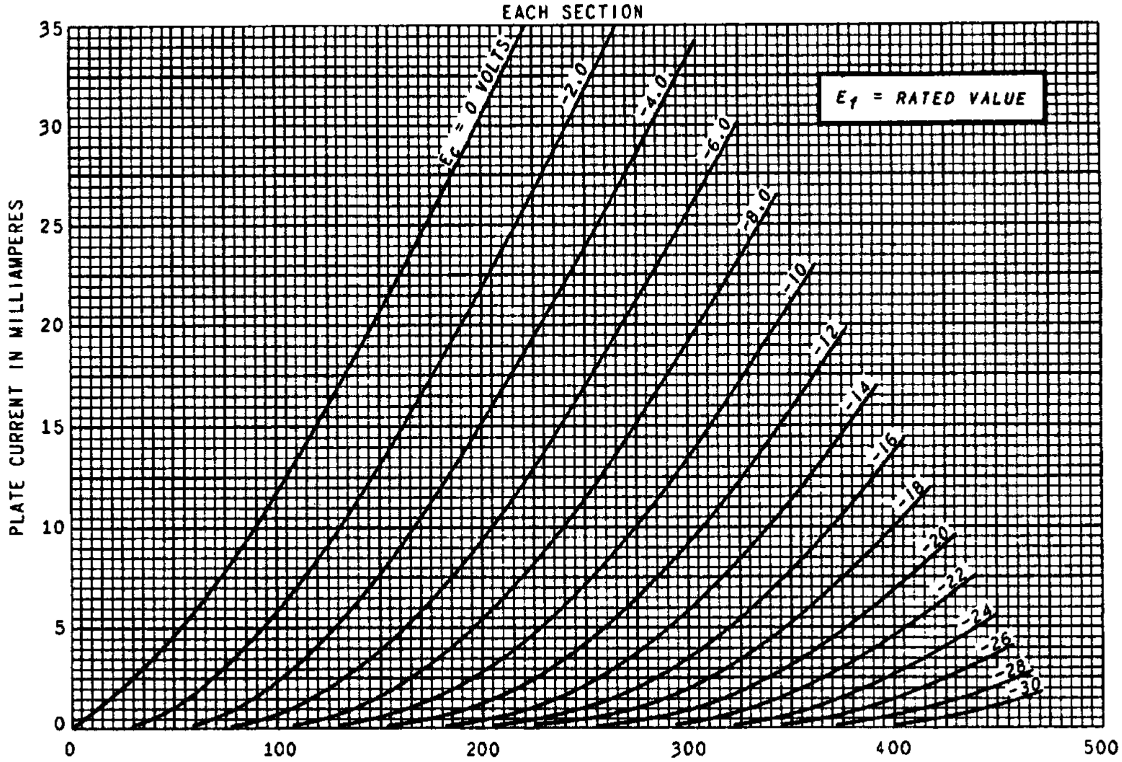
EACH SECTION



K-55611-TD172-1 MARCH 8, 1962

AVERAGE PLATE CHARACTERISTICS

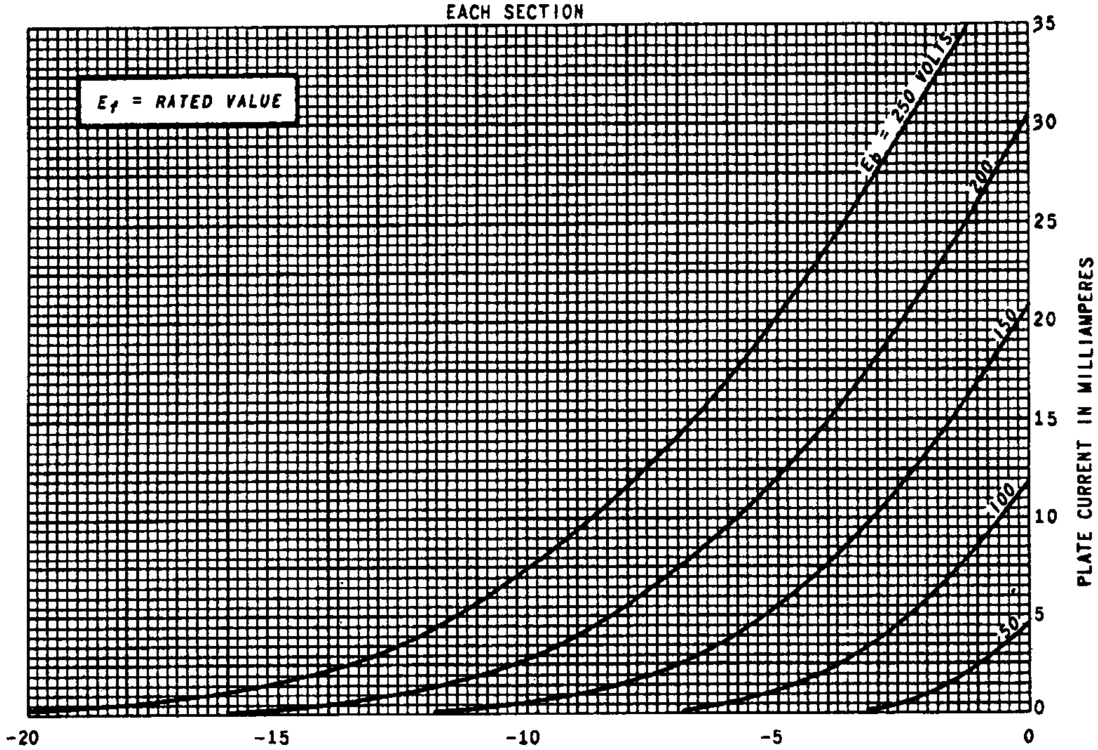
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AVERAGE TRANSFER CHARACTERISTICS

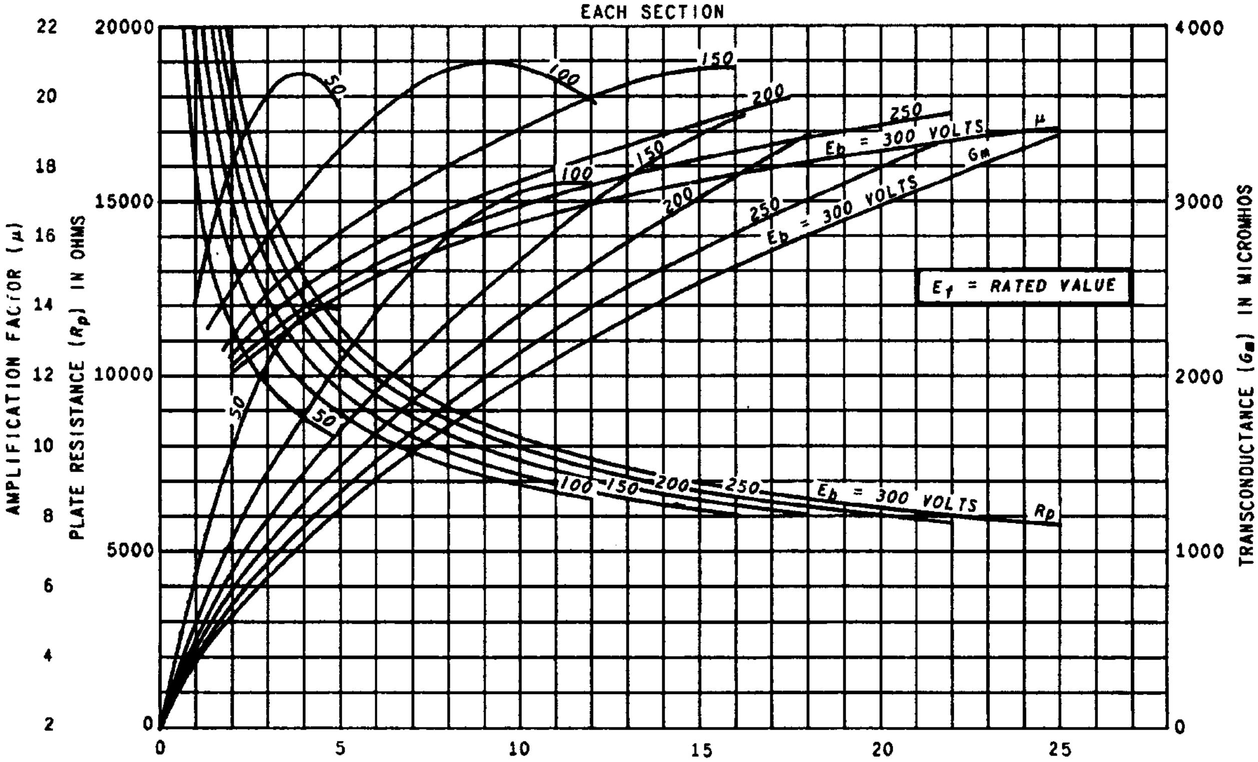
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AVERAGE CHARACTERISTICS

EACH SECTION



K-55611-TD172-4 MARCH 8, 1962

TUBE DEPARTMENT

GENERAL ELECTRIC

Owensboro, Kentucky